Focus

Environmental Equity: A New Coalition for Justice

A widening spectrum of the nation's diverse peoples believe that a healthy environment is a basic right of all of earth's inhabitants regardless of race, income, or social background. The new voices in the environmental movement include African Americans, Hispanic Americans, and Native Americans, minorities in the population of the United States, who are asking questions about the environment and their health, many of which appear to have no ready answers. In the emerging discussions, the terms "environmental equity," "environmental justice," and "environmental racism" refer to different but overlapping elements and are increasingly used to define and address facets of environmental health issues.

Environmental racism refers to the historical pattern of discrimination against people of color in the United States. Not only does this discrimination limit housing choices and job opportunities for many citizens, it carries over into decisions made at the local level. For example, some of those decisions allow less desirable land uses, today referred to as LULUs (locally unwanted land uses) in and near neighborhoods without political power. These neighborhoods often consist of minorities and the poor. According to activists, that kind of discrimination, with its environmentally malignant baggage, continues in many communities around the country.

Environmental equity refers to the perceived unequal burden borne by minorities and the poor in terms of where municipal landfills, incinerators, hazardous waste sites, and industries producing toxic emissions are located. It also refers to diminished civic benefits such as paved streets, efficient sewer systems, and treated water connections. Lack of services in minority and poor neighborhoods is often linked to persisting racism and its consequences. Race and socioeconomic status are also linked in some studies to chronic exposures to greater than acceptable levels of environmental pollution.

Environmental justice refers to environmental regulation, environmental law enforcement, and environmental cleanup programs, including those in the workplace. Those active in the environmental justice movement maintain that communities where racial and ethnic minorities are a majority of the population get less attention when it comes to enforcing environmental laws and are at the end of the list in programs to clean up hazardous sites that threaten community health and well-being. Part of the problem, activists and some government officials agree, is the absence of racial and ethnic diversity in the government offices where policies and practical decisions are made. In many communities, minorities are also missing from local governments that decide these matters.

People working on environmental justice issues are attacking the problems through at least three routes: congressional legislation, executive order, and uniform enforcement of existing laws. Meanwhile, optimism is growing that the opportunity exists to bring together those concerned with equity. There has been very little cooperation among federal agencies in the past, according to some. The view is that agencies need to involve grass-roots organizations in affected communities in designing, developing, and carrying out prevention and remediation policies. Reaching the minority community means linking to churches and schools, and, activists say, agencies need to build working relations with the vulnerable populations through such community institutions.

Early Awareness

Awareness of the environmental justice movement is generally dated to the 1982 demonstrations by residents of Warren County, North Carolina. These citizens objected to the state's choice of their rural, poor, largely African-American county for a hazardous waste site for polychlorinated biphenyls (PCBs). County citizens were joined in protests by mainstream, historically white environmental organizations and by civil rights leader Benjamin Chavis, now executive director of the National Association for the Advancement of Colored People.

The next widely recognized milestone for the movement was the 1987 publication of *Toxic Waste and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites.* That study by the United Church of Christ's Commission for Racial Justice looked at racial and socioeconomic characteristics of Americans living in residential areas around commercial hazardous waste sites and near uncontrolled toxic waste sites (often abandoned production operations or unregulated dumps). Race, described as the minority percentage of the population, was the strongest predictor of location for commercial hazardous waste activity.

The commission's study found that three out of every five African-Americans and Hispanic Americans live in communities with uncontrolled toxic waste sites: a total of more than 15 million African-Americans and 8 million Hispanic Americans. Another 700,000 Native Americans and 2 million Asian and Pacific Islanders were estimated to be living in communities with uncontrolled toxic waste sites. The study expanded on data originally gathered by the General Accounting Office for the southeastern United States and broadened the base by looking at the census data for similar sites in other parts of the country.

Legal Headway

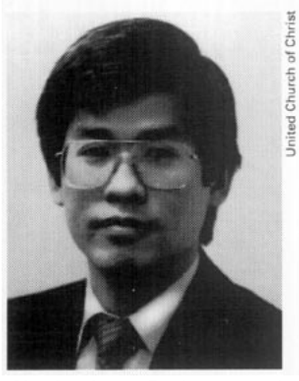
In response to studies such as the United Church of Christ's and a growing tide of public sentiment and activism, some of the nation's leaders are taking the reins to remedy environmental inequities. Says Robert Bullard of the University of California-Riverside, "It should not be hard to be on board for this. Where there are people, there have been priorities. [The] question is why some people and areas were underprotected, and some laws underenforced. It says some populations are less valuable."

Echoing this analysis, the proposed Environmental Justice Act of 1993 may shift the terms of the debate from those of the early ecology movement to those used by the civil rights movement. This legislation has been introduced in the House of Representatives by Congressman John Lewis (D-Georgia), with 25 co-sponsors, and in the senate by Senator Max Baucus (D-Montana) and co-sponsors Carol Moseley-Braun (D-Illinois) and Ben Nighthorse Campbell (D-Colorado). The bills identically state their purpose as "to establish a program to ensure nondiscriminatory compliance with environmental, health, and safety laws and to ensure equal protection of the public health."

Both versions of the legislation mandate data collection for emissions, demographic details, and human health status, identification of 100 geographic locations (counties or smaller geographic units such as neighborhoods) most heavily affected by toxic and hazardous wastes, and efforts to determine whether the emissions and health status of residents are linked. The bills also ask the responsible federal agencies to identify exposure thresholds for health effects.

The lists of federal offices named in the two bills are not identical, but support the description of the environmental justice movement repeated by Robert L. Knox, deputy director of EPA's Office of Environmental Equity, in the *Journal of Environmental Health*, as the "merger of the environmental and civil rights movements."

The legislation, said Charles Lee, director of the Toxic Waste and Race Study and now head of the United Church of Christ's Commission for Racial Justice, "puts the focus on public health and environmental pollution." Said Lee, "In the laws that existed before this, we had a lot of regulation of one toxic in a single medium. This starts to approach multimedia multipollutants, a big factor in communities of color. By reviewing all of the communities in the country, we'll see where the worst problems are."

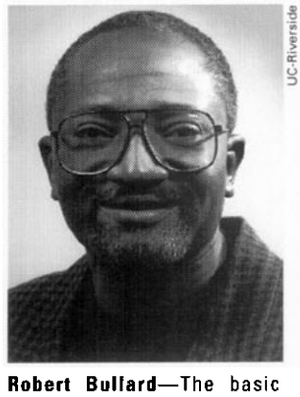

United Church of Christ

Charles Lee—Environmental justice legislation will put statutory teeth in the movement's efforts.

Many existing regulatory and enforcement programs need to be targeted by the environmental justice movement so that resources can be funneled where there are disproportionate impacts, Lee added. The nation has "no long history of considering public health and environmental impacts" as a pair, and an awareness of their links came about not much before the creation of the EPA, he said. Speaking of the commission's efforts, Lee said, "We looked at race and class versus distribution of environmental impacts. Race was the more significant factor. Economic class was also important. There are issues of race, and then of racism itself."

"We're not saying pollution is okay if it's not in a community of color. We advocate justice for all. Pollution prevention is the ultimate goal. When we speak of environmental justice, this legislation will not solve it all. It will put statutory teeth around environmental justice. It will make sure the data are being gathered," Lee said.

Social scientists and biomedical scientists, including epidemiologists, are trying to document the nature and extent of the disparities reported in the United Church of Christ study. They are looking for data to answer the question of whether minorities are bearing a disproportionate share of the environmental impacts on health and quality of life of the nation's waste management practices, particularly for toxic and hazardous wastes. "The data that exist are sorely lacking in many ways," Bullard said. "What we have now is not very good data on emissions, lousy data on exposures, even lousier data on health impacts. The environmental justice bills will address data gaps that need to be plugged."


UC-Riverside

Robert Bullard—The basic question is why environmental racism exists.

The major flaw in the current environmental justice legislation is that it doesn't go far enough, Bullard says. At the same time, he added, "it's a foot in the door, and that's the nature of Congress." Concurrently, the House and Senate bills elevating EPA to cabinet status both have a provision to establish an office of environmental justice within EPA.

New Approaches to Old Problems

Bullard, a professor of sociology and a leading chronicler, advocate, and analyst of the environmental justice movement, became a nationally recognized figure in environmental justice discussions with the publication of his 1990 study, *Dumping in Dixie: Race, Class, and Environmental Quality.* One block to understanding equity problems, Bullard argues, "is the general assumption by the media and [public] agencies that all are impacted equally by emissions. Many communities are overlooked."

Rae Zimmerman—Communities want to be involved in the process and the solutions.

Because race is the dominant association for discrimination in enforcement of environmental controls, changing the way the nation addresses its environmental problems is appropriately a political and economic debate. Disease prevention and pollution prevention go together, according to Bullard. "We have to recognize it is a political and economic debate. Environmental inequities, elitism, and racism are a package," he said.

Bullard contends that environmental inequities should be addressed across agencies—EPA, HUD, the Department of Health and Human Services, and others—by focusing on the disease prevention/pollution prevention strategy. The work also needs multidisciplinary approaches in the social sciences, the biomedical, and ecological sciences to address the issues and questions of environmental equity. Scientists need to be talking to each other.

Bullard believes that economics are a secondary consideration in unequal protection from environmental insults, though he says racism and economics are interrelated. "We could eliminate environmental problems and still have differences," he noted. "There is discrimination in what questions are asked and in who does the studies."

One scientist involved in Bullard's study is Rae Zimmerman, professor of planning and public administration in the Robert F. Wagner Graduate School of Public Service at New York University. Zimmerman is applying environmental epidemiology and risk analysis to the question of whether health varies by race.

The first thing to remember, Zimmerman says, is that statistical analyses like those in her studies generate associations, not definitive cause-and-effect findings. In a paper scheduled for publication later this year in the journal *Risk Analysis*, Zimmerman examines questions of social equity and environmental risk at Superfund sites across the nation. The study builds on earlier work supported by a grant from EPA's Office of Solid Waste and Emergency Response. Past studies have asked similar questions at the county level. Zimmerman looked at municipalities to see whether there were identifiable differences in exposure levels by race, ethnicity, and income.

While there is much work still to be done, especially at the census-block level (the basic data-gathering unit of the Census), some information consistent with almost all previous studies has emerged from the analyses, Zimmerman said. Studies indicate that a slightly higher percentage of blacks than the national average live in communities with National Priority List sites (sites designated for cleanup under the Superfund law): 18% blacks in NPL site communities versus 12% blacks in the national population. At the same time, the study found no association between poverty and residence near NPL sites.

In examining the issue of equity in enforcement of environmental regulations, Zimmerman has looked at EPA records of decisions (RODs), the official record of

EPA actions covering plans for cleanup of NPL sites. The longer a site has been on the NPL, the more likely it is to have an ROD. At the same time, "communities more likely to have Superfund RODs are less likely to have higher numbers of minorities," she said. The year 1986 appeared to be the watershed. According to Zimmerman, in 1986, the number of sites where more minorities are found increased on the NPL.

Said Zimmerman, "We have to move forward on trying to measure some things. Most of the Superfund site studies . . . are finding trends with race. . . . The real problem with Superfund sites is finding out who's at risk. We haven't been able to use reliable measures of health risk; there are some weak measures. Risk analysis is embedded in the process [of risk identification and risk assessment]."

Zimmerman continued, "A lot of attention should be paid to doing the epidemiology that's needed. We have changing exposures, changing populations. Communities want to do their own monitoring, and at least have some oversight on what's being done. We may have good numbers on community diseases but not on what caused the diseases. It's important to get going to prevent future problems."

Environmental Equity Case Study

An environmental pollutant that most agree disproportionately affects African-Americans is lead. The assistant administrator of the Agency for Toxic Substances and Disease Registry, Barry L. Johnson, and co-author Sandra L. Coulberson reported in the March 1993 *Annals of Epidemiology* that 46 % of the 3–4 million American children ages 6 months to 5 years who were identified in the ATSDR's 1988 report to Congress on childhood lead poisoning as being at risk for lead toxicity were African-Americans. This was a percentage out of proportion to their numbers (2,483,400 or 17.9%) in the total population (13,840,000) in the at-risk age range.

Janet Phoenix, head of the National Lead Information Center, agrees that the poor and minorities bear a disproportionate share of the burden of pollution. Said Phoenix, "Though lead is not a waste so much as a toxin in the environment, I do have a sense that there are differences in health status. The poor tend to have more than one toxin as exposure factors."

Phoenix continued, "In looking at poverty as a factor, the poor are ill equipped to respond aggressively to cleaning up hazards in their own communities. It's also easier to site such operations in poor communities. The residents are often uninformed, and the prospect of employment is dangled before them along with other resources for the community, although these often don't materialize."

The National Lead Information Center that Phoenix directs is funded by four federal agencies: EPA, CDC, HUD, and the Department of Defense. From her perspective of working extensively on lead exposure and health problems, Phoenix noted that there can be unintended consequences and disproportionate impacts of regulation. "Title 10 housing for the elderly is not subject to the same health and safety regulations as other public housing, based on the presumption that nobody under the age of 6 would live there. However, the poor often live together in multigenerational households," she said. Therefore, although the regulations were supposed to lower costs of housing for the elderly, she said, the unintended consequence was potential exposure of young children to unsafe levels of lead in paint, soil, and dust at some of these units. "At the heart of the matter," Phoenix said, "is the problem of little communication between the poor and the regulators. The regulators are writing . . . regulations based on regulatory perceptions, not community input."

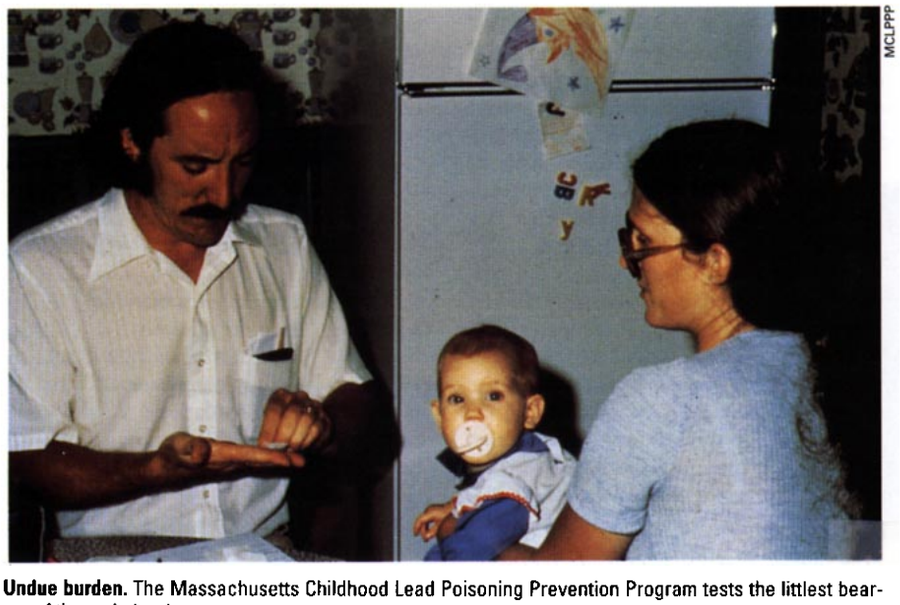
The communications gap persists at the National Lead Information Center. Most of those who call for information are in higher socioeconomic strata than the groups most likely to be at risk of exposure to lead. "The poor tend not to gain much of their information from the written word. They're not sure, if they call, that they'll get the information they need. It makes our service less useful to the highest risk communities. To help bridge some of these gaps, we go out to the high risk communities to try to make the connections one on one," Phoenix said. The center is working on low- and no-literacy materials as well. It has bilingual materials for English and Spanish and is working on materials in Southeast Asian languages.

As Phoenix attends planning and policy meetings around the country, she advocates alternative viewpoints in approaching environmental health problems. Some of her colleagues argue that the disparities are based on race, not economics, but Phoenix believes the demographic data just aren't there, noting "we see similar patterns along the Mexican border and in the Northeast."

Research Needs

Sensitive and susceptible people may make up an additional population of concern because of the way many of the laws governing EPA activities are written, noted Kenneth Sexton, director of EPA's Office of Health Research. Laws covering EPA activities often include provisions for pollution control that protect the most susceptible. Determining the members of that special group is an emotional and a scientifically challenging task, Sexton said. Overlap with issues of equity, justice, and racism add to the complexities.

In Sexton's office, the concepts and questions incorporated in the term "environmental justice" have become high profile. Sexton said that when the agency tried to look at current research to see how it addressed environmental equity issues, "We found the past research useful but without much focus on equity questions. There was not enough data on socioeconomic factors and ethnicity. We don't need to apologize for the research that had been done, but it's apparent we haven't focused enough on the economic and social aspects."



Undue burden. The Massachusetts Childhood Lead Poisoning Prevention Program tests the littlest bearers of the toxic burden.

A major issue in the environmental equity area for EPA is exposure assessment. Sexton observed, "We need to measure and understand which populations are at the high end of the distribution for focal chemicals. There's not adequate information on ethnicity. At the same time, until we understand the general population, there's nothing to compare the subpopulations with. A major hole in environmental health data is the baseline exposure of the general population. It's amazing how little attention has been given to what is an appropriate baseline, and to what exposure data to get."

USEPA

Kenneth Sexton—A major data gap is the baseline exposure of the general population.

The EPA has been working on exposure analysis with ATSDR and the National Center for Health Statistics. There has been a workshop to determine what the data needs are, and the EPA has published an inventory of existing federal databases to improve access to information.

Human exposures. The recently formed National Human Exposure Assessment Program is intended to fill some of the human exposure data gaps through studies of a representative sample of the U.S. population. The pilot studies begin in fiscal year 1994 in EPA regions V and IX. The studies will look at a broad group of chemicals, with repeated sampling performed at three-year intervals. The pilot studies will help EPA assess how well the program works, how the field study goes, and how cost effective the program can be, Sexton said. "The approach appears to be feasible. It clearly is essential to asking the needed questions."

Geographic information systems. Geographic information systems are being used more and more and may be important in evaluating inequities and disparities in subpopulations. The approach helps regions integrate emissions data and census data, particularly in the case of the Toxics Release Inventory (TRI). EPA is close to finishing a project looking at socioeconomic measures, ethnicity, and demographics at the county level, Sexton said. However, he cautioned, "The TRI is not a good surrogate for exposure. It's the best we have, and it can serve as a direction finder."

Interagency efforts. In cooperation with NIEHS and ATSDR, EPA has been looking at research needs associated with questions of environmental equity. A group of papers on public health research needs

Environmental Outreach

The training of cleanup workers, environmental health professionals, and scientists to pursue research into the links between environment and human health and diversifying the racial, ethnic, and gender mix of potential environmental health professionals and policy makers are becoming new priorities at local and federal government levels. The outreach programs designed to accomplish these goals are as varied as their geography.

In Ann Arbor, Michigan, at the Washtenaw County Environmental Coordinating Office (ECO), Rebecca Head directs an office that has placed the water, solid waste, environmental health, and public works programs under one umbrella to address public service needs and communicate with citizens on environmental issues.

The office is reaching out to the next generation and to the issues raised by the environmental justice movement as well. Part of the approach comes from Head's training as a toxicologist. "Past practice in public health said that if people had bacteria-contaminated water, you removed the people from exposure and then you looked at the source of exposure," Head noted. "Now, in addition to public health policies and toxicological issues and policies, we're asking how these exposures impact communities of color."

Her office has college students serving year-round internships from the University of Michigan. A summer internship for minority high school students exposes them to public service careers and to careers related to environmental health. The high school interns spend time in different agencies under ECO, going with sanitarians on inspections, taking water samples, doing waste sorts to evaluate the waste stream, and writing reports on their findings.

"Part of the interns' education is exposing them to what organizations are there, available for use by the community. They learn about recycling, about alternatives to the old ways of waste handling. The people conducting the program gain a real awareness of the mixture of sophistication and naiveté in these young people. The young people come from areas with recycling, yet there's not the awareness of waste, how one can approach it differently," Head said.

The ECO program is making links with the young people and their communities through churches, block groups, and the like. Workers from the office and the interns go out to groups in the community, and the young people talk about their ECO experiences. In addition, the office has an advisory committee to help shape ECO programs.

The ECO internships are in the second year under an EPA Environmental Education grant. "I'm not sure how we'll fund the program next year, but we'll find a way," Head said. "We want to make links within the community. It's important that we as public employees remember who our customers are. Sometimes we lose sight of who we serve. Also, government has to show what it's doing, what the people are getting for their tax dollars. People are just not going to pay for things any more unless they think they're worth it. With these high school students of color, we're reaching out to the communities."

Developing future environmental health professionals is a long-term commitment and a challenge for Marian Johnson-Thompson, director of the Office of Institutional Development at NIEHS in North Carolina.

In addition to her responsibilities of encouraging and broadening access to professional development within the institute, Johnson-Thompson is developing a kindergarten through 12th grade program that will expose children early and often to the excitement, problems, and opportunities in environmental health sciences.

Said Johnson-Thompson, "We must expose the kids to the environmental health sciences at a very early age. Statistics show that children's early abilities are quite alike. We need to continue nurturing those abilities rather than letting expectations cut off further development. We need to educate the parent to be involved, as in the family math program. We have to overcome the cultural bias in some quarters about not doing 'white man's work.' We must make everybody literate so we can reach them. It's a long-term . . . investment if we are to get a representative mix—representative of the nation's people—at decision-making levels."

Diversity in the makeup of those doing research, setting policy, and working on environmental health issues will make a difference. "As we saw in the women's health initiative at NIH, once we had women trained in the relevant fields, they gained respect, could raise the issues that had not been addressed, and had the motivation and perspective that had been missing," Johnson-Thompson said. "If we have trained minorities in decision-making positions, others will listen."

commissioned by the agencies is currently being published. A symposium on public health research needs related to environmental equity is scheduled for 10–12 February 1994, with NIEHS as the lead agency, that will follow-up on the issues as well as raise awareness of the issues, Sexton said.

NIEHS has convened several interagency meetings to improve communication and cooperation among the agencies in a number of environmental research areas, and the expansion to the area of environmental equity was a natural progression. The institute has invited grass-roots leaders and social scientists to join the biomedical scientists and agency policy makers in a symposium on the concepts, research challenges, and disease prevention and health promotion opportunities embodied in the concepts of environmental equity and justice.

In one of EPA's newest offices, the Office of Environmental Equity, the staff is coordinating equity efforts between headquarters and regions. In addition, said the office's deputy director, Robert J. Knox, "There is a broad-based commitment by the [EPA] administrator and the [Clinton] administration to incorporate environmental equity considerations across the agency's activities." Along with its internal role, the office is overseeing the EPA's Minority Academic Institutions Program, part of the broad government effort to increase the numbers of minorities entering science and engineering.

The Agency for Toxic Substances and Disease Registry is one federal office that has been in the trenches gathering data specifically on who is exposed to toxics from known hazardous sites for about five years. At ATSDR, Barry Johnson and his colleagues have been asking questions about the distribution of environmental toxics and hazardous exposures by race since 1987. Currently, ATSDR is 15 months into planning for its Delta Project, which will look at the relationship between environmental hazards and the health of minority populations in a 214-county swath through 7 states along the Mississippi River, in cooperation with local communities and institutions.

The Delta Project. The Delta Project is expected to work through the Historically Black Colleges and Universities (HBCUs) in the region, beginning its information base with data that state and local health departments have compiled on environmental health problems.

There are a number of goals for the project, Johnson said. "We plan to start with a needs assessment. We don't want to just come in and say, 'You've got another problem.' We hope to sort out what can be done across federal agencies. The question arises of how to involve the communities. These people pay our salaries, and their communities must be involved in the study effort."

That's one of the roles for the HBCUs, which may serve as community voices. The capacity of the schools to contribute to the studies will be identified, and the agency will seek to build a network of local support, working in phases, with the focus on problems, with opportunities for redress that can go directly to the community, Johnson said. "The legislation now in Congress, with its concept of acquiring, dedicating, and focusing some effort on improving information on minorities and environmental health, is a meritorious approach," Johnson said.

ATSDR has looked at issues of lead in children, location of people around haz-

Making Plans to Find Solutions

A recent planning meeting to address the need for additional health research to cure the ills of environmental inequities brought together 43 professionals representing U.S. government agencies, hospitals, colleges, universities, ecumenical and community groups, as well as physicians, lawyers, and educators, to discuss a subject that they believe will be the next environmental battleground.

Sponsors of the symposium were the NIEHS, U.S. EPA, Agency for Toxic Substances and Disease Registry, Department of Energy (represented by Argonne National Laboratory), and the National Institute for Occupational Safety and Health.

"There is a sense of renewal in our coming together," Jerry Poje, a toxicologist with NIEHS, said to meeting participants. "There are issues here that have far too long been dormant."

Health care, housing, lead poisoning, training of minorities for environmental management positions, environmental health education for grades kindergarten through 12, asthma, the lack of training of doctors in the prevention of occupational diseases, and health care rights for all were some of the topics discussed.

"Time is of the essence in doing active work in health equity," Poje said. He added that new directives from the White House addressing environmental justice and President Clinton's plan to hold a national summit on environmental issues dictate that government agencies come together to establish goals in eliminating environmental inequity.

The two-day planning symposium held at Argonne National Laboratories in Illinois was a hands-on meeting that laid the foundation for a national conference scheduled for 10–12 February 1994 in Washington, DC. About 500–700 people active and interested in environmental equity issues will attend.

A common question raised during the meeting was whether the agencies were tackling issues that are too broad. "Will there be a backlash in our efforts to make changes?" asked Charles Lee of the United Church of Christ's Commission for Racial Justice.

Bunyan Bryant of the University of Michigan's School of Natural Resources emphasized to the participants the importance of the meeting. "If we put ourselves together, we can put our communities together. And, if we put our neighborhoods together, we can put our world together," he said.

Bryant, who authored the book, "Race and the Incidents of Environmental Discourse: The Time of Discussion" believes that the environmental justice movement has the potential to make the regulatory agencies embrace the policy of pollution prevention rather than pollution control.

Bryant said, "There needs to be agency and interagency cooperation. If this is done successfully, there is a good chance that researchers and agencies will work together to look at new research paradigms."

A major portion of the conference was devoted to workshop participation where group members discussed topics that will be addressed at the February conference.

At that conference five workshops will address environmental health research needs; environmental health education and training; environmental outreach, accessibility, and accountability; institutional mandates and interagency cooperation; and environmental health prevention and intervention strategies.

A recurring theme throughout the symposium was the agreement among participants that there needs to be health equity among all socioeconomic groups and that environmental factors that contribute to disparity must be identified and remedied.

Pamela Johnson

ardous waste sites, and effects of pesticides on minority workers. It has some information that needs expanding: data that support the conclusion that people who live around waste sites are minorities. The work recommended in the Commission on Racial Justice report needs to be done, Johnson added. To date, ATSDR has found that 2% of evaluated hazardous waste sites present "no public health hazard"; 2% present an "imminent and urgent public health hazard"; 40% have human exposures to releases from the sites; and 40% have potential exposure sources.

Johnson described another collaborative effort by ATSDR on environmental equity. "As a federal agency," Johnson said, "we have done a fair amount of looking at toxins and their effect on Native Americans. The matter of fish consumption with a lot of contaminated waterways means too much consumption can lead to health problems. At the same time, we want to be respectful of native customs and cultures. We also have to be aware of the subsistence aspect . . . we cannot be insensitive. We've had a lot of consultation with the Indian Health Service, and the IHS could not be more cooperative."

A request from the Navajo Nation's Superfund Program Office led to a successful outcome. The Navajo office asked EPA for help in determining whether uranium mine tailings on Navajo land might be a health hazard. EPA's regional office asked ATSDR to take a look, Johnson said.

Uranium mine tailings consist of uranium ore with uranium levels below a certain level required for extraction. The Navajos had used some of the tailings for building material and some for decoration around buildings. ATSDR found radiation levels "of health concern." The agency wrote a health advisory, a major Public Health Service statement, that went to EPA. A health advisory can put a waste site on the NPL with a high hazard ranking system score, the usual route to the NPL. EPA got the ore out of the area and out of houses and removed the decorative stones. Within six to eight months from the initial inquiry, the hazard had been removed.

"The biggest challenge for public health is awareness creation . . . in the scientific and public health communities," Johnson said. "Residents of the affected communities are aware there are problems that are the products of poverty and disenfranchisement, of the communities not being part of the decision-making process.

Diversity. Johnson described an important aspect of the environmental equity and justice equation that concerns who is involved in forming solutions to these problems. Said Johnson, "Another challenge for public agencies is that we must look like the public we serve. Otherwise, there's no credibility. Public sector agencies have to work to make themselves and their staffs diverse. We need to support the schools that are producing the [minority health] professionals. . . . The government has to commit the resources and stay the course."

Lee, the Commission for Racial Justice director, expounded on the concept of diversity, saying, "part of the problem has been the limited background, the absence of diversity among those who enforce environmental laws. It's no big surprise that they haven't asked the right questions." The matter had not been considered a real issue by the communities of color, he added.

The recent elevation of Benjamin Chavis, who participated in the Warren County protests, to head the NAACP brings environmental justice to the forefront of social justice issues, Lee said. It also makes sense that training and jobs in environmental cleanup should be part of the environmental justice package, he continued, adding, "The issue cuts across a number of levels."

The United Church of Christ Commission has been associated with two landmark national events related to environmental justice: the preparation and publication of *Toxic Wastes and Race*, and the first National Conference of People of Color on the Environment, held in October 1991.

According to Lee, "The conference was an exercise in leadership on the environment. . . . The people who will make a difference are the grass-roots leaders. The conference was to be a platform for these grass-roots leaders to have national visibility. My hope is that it will eventually be as significant as the first Earth Day. The conference meant a redefinition of the concept of environmentalism; it was a refocusing. We have a lot to learn from the indigenous peoples about harmonious and beneficial use of our environment."

Lee outlined where he believed environmental justice and equity efforts should focus next. "First, we must put environmental health in the centerpiece of the environmental movement. The [Environmental Justice] Act is part of that direction. Second, environmental cleanup is a source of jobs in a period when jobs are being lost and especially in urban areas where it could mean making jobs that pay a living wage. The third area is understanding and reshaping the way decisions about environmental issues are being made. We need to use local experts, people who have lived with the problem, in making difficult choices about remediation of hazardous sites."

There is no question that real and substantial efforts are under way to broaden access to the process and procedures that accompany official environmental protection in the United States. Efforts by federal offices to include more of the citizens who are directly affected by environmental regulatory decisions and community representatives in making the decisions that affect their daily lives are likely to go through some birthing pangs. A key to smooth progress will be how well both sides listen to what the other is saying. Groundwork for listening, sharing a common vocabulary for the discussions, is being laid in meetings like the one planned by NIEHS in February. As sociologists and scientists sort through their mutually exclusive jargons, it is likely that the grassroots leaders mentioned by Lee and Bullard will have to keep the academics' eyes on the prize: a safe and healthy environment for every citizen, based on sound information, good science, and fair laws that are enforced equitably.

Betty Mushak

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In Our Own Backyards: The Continuing Threat of Hazardous Waste

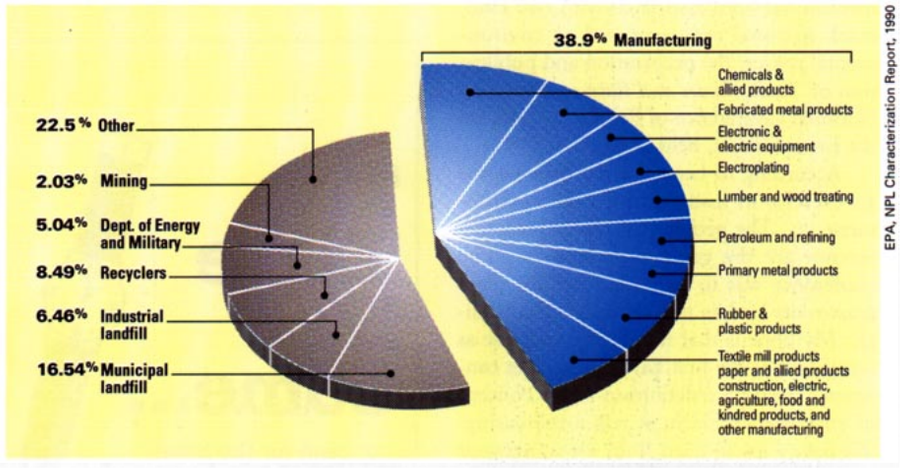
The Environmental Protection Agency estimates that between 20 and 40 million Americans live within four miles of the country's worst hazardous waste sites. For public officials charged with protecting human health, determining the health impacts associated with those sites is complicated by scientific and political controversies and, at times, crippling economic and budgetary constraints.

The two federal agencies primarily responsible for making such determinations, EPA and the Agency for Toxic Substances and Disease Registry (ATSDR), are subject to criticism from industries facing cleanup bills, from citizen's groups who believe the agencies are not appropriately responding to the human health threat, and from some scientists and health professionals who tend to line up behind either the industry or citizen's groups. Against this backdrop, federal and state officials must decide which hazardous waste sites pose the most significant health risks and determine the proper means of preventing exposure or reducing exposure from those sites.

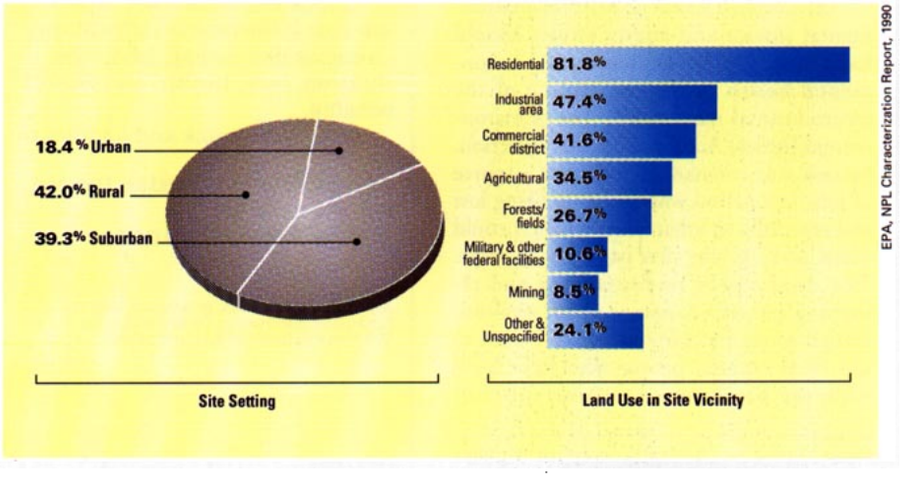
How Much of a Threat?

Approximately 36,000 sites are included in an EPA database of possible hazardous waste sites, according to EPA spokesperson Wendy Butler. Of that number, EPA has determined that 22,000 require no further federal action, presenting "either no threat or insufficient threat," or will be dealt with by the site owner or the state. Ten thousand sites warrant further consideration, and 3000–4000 have not yet been assessed, according to Butler.

The worst of the sites known by EPA and evaluated by the agency are listed on the National Priorities List (NPL) of sites designated for cleanup under the Comprehensive Environmental Response, Compensation and Liability Act (the Superfund law). About 100 sites are added to the list each year.



Where did it all come from? Wastes at NPL sites are generated from myriad sources.



In everyone's backyard. NPL sites are found in all settings and each site may contain many varied land uses.

As of July 1993, 1270 sites have been proposed or actually listed on the NPL. Sites listed on the NPL have undergone a complete site assessment by EPA, including a risk assessment to gauge the potential of the site to affect human health. Sites representing an imminent hazard are dealt with under EPA's emergency response authorities under the Superfund law.

The Superfund law, as amended in 1986, requires ATSDR to conduct health assessments of all sites listed or proposed for the NPL and to conduct further health studies or other activities as necessary. In addition, Congress instructed the agency to rank substances that are the greatest hazard to human health and are likely to be found at NPL sites and prepare toxicological profiles of those substances.

In testimony in May before a Senate Environment Subcommittee, Barry Johnson, ATSDR assistant administrator and assistant surgeon general, summarized the agency's findings thus far about the impact of hazardous waste sites on human health:

- Data from Superfund sites suggest that proximity to hazardous waste sites is associated with a "small to moderate increased risk of some kinds of birth defects" and some types of cancers, though the cancer association is "less well-documented."
- Investigations of some individual sites revealed increases in risk of birth defects, neurotoxic disorders, leukemia, cardiovascular abnormalities, respiratory and sensory irritation, and dermatitis.
- Many studies have shown no adverse health effects.
- Human exposure has been documented at about 40% of the sites, and there is potential for exposure at another 40%, though actual exposure levels vary widely by site.
- Elevated exposure levels of lead, PCBs, arsenic, cadmium, chlordane, mercury, and a herbicide have been found in individuals studied at 12 sites.

Johnson said ATSDR lacks sufficient data to determine whether human exposure is possible from 40% of the sites, and therefore the sites represent an indeterminate risk. The agency has classified 35% of the NPL sites as "public health hazards," and 20% of the sites represent "no apparent public health concern," though exposures have occurred at those sites, while another 2% of the sites are categorized as presenting "no public health hazard."

ATSDR has ranked the 275 most hazardous substances at NPL sites. The top 10 contaminants are lead, trichloroethylene, benzene, arsenic, chromium, cadmium, tetrachloroethylene, toluene, di(2-ethylhexyl)phthalate, and vinyl chloride,

Johnson told the Senate hearing.

ATSDR health assessments of NPL sites are based on three data sources: environmental data, such as sampling results, provided by EPA; health outcome data, which are gleaned, when available, from cancer and other disease registries and birth and death records; and community health concerns, according to Michael Greenwell, ATSDR spokesperson.


ATSDR

Barry Johnson—Government agencies must anchor health assessments to good science and good public health policy.

During the health assessment process, the agency attempts "to get a general idea about what the health concerns are and to determine if a higher incidence [of an ailment exists in a community] than would be expected," said Greenwell. At the health assessment level, the agency does not usually request medical records of individuals.

"If we think indications suggest there might be a health problem, then we might recommend doing a health study," Greenwell said. Health studies involve conducting an exposure assessment and/or a disease and symptom prevalence survey and determining if there is a link between a site and illness in a community.

To make such a connection, the disease prevalence in a community is compared against a similar population in the state. But according to Greenwell, "we acknowledge the sample might be so small that it makes it difficult to arrive at a conclusion." In such instances, ATSDR attempts to combine information from the site with other sites with similar environmental characteristics.

Sites Unseen?

Greenwell noted that in ATSDR's early years, most health assessments of NPL sites were based exclusively on environmental data. When Congress reauthorized the Superfund law in 1986, it instructed ATSDR to complete health assessments of listed NPL sites by December 1988 and to complete site assessments within one year after the sites are proposed. ATSDR met the deadlines, but only by performing less than thorough assessments.

The quality of the agency's work was reviewed in an August 1991 report by the General Accounting Office, which found that the tight time frames for completion of the assessments prompted ATSDR to use existing documents such as health assessments of Superfund sites or to rely on old data as the basis for many assessments, without obtaining additional information, conducting site visits, or communicating with local or state officials. The quality of the assessments prevented ATSDR from accurately assessing the human health impact of the sites it assessed, GAO said.

ATSDR does not contest GAO's assessment of its early health assessment studies, according to Johnson. "But the GAO report didn't put into perspective the conditions under which we were working," he commented. The agency had fewer than 20 staff members to conduct the nearly 1000 health assessments required by the Superfund Reauthorization Act. In addition, the agency has long been plagued by a gap between its funding and personnel allocations, Johnson said, because funding for the agency's Superfund work comes through EPA, while the size of the agency's workforce is determined by the Department of Health and Human Services. "We're not different than most other government agencies," said Johnson. "The level of effort expected by the public exceeds what we can deliver. That's the way it is."

The discrepancy between the activities of the agency and the performance demanded by the public is illustrated by the scathing review of the agency's work in a report produced by two citizens groups, the National Toxics Campaign Fund (NTCF) and the Environmental Health Network (EHN). The May 1992 report, *Inconclusive by Design*, charges that ATSDR has had inadequate contact with populations being assessed for health impacts from hazardous waste sites, relies too heavily on epidemiology studies to determine whether a community has experienced an increased incidence of disease, used inappropriate testing techniques to measure the type of exposure involved, and studies the wrong health problems; for example, focusing on lethal ailments like cancer rather than the nonlethal ailments communities complain about.

Linda King, executive director of EHN, believes ATSDR relies too heavily on data generated by EPA. Many times the information is collected and generated by parties that may be legally liable for cleanup of a site, such as the owners of contaminated property, she said.

"If the information used to assess [health effects] is fraudulent or inaccurate, how can the assessment of community health needs be accurate?" King asked. The citizen's groups are also frustrated by the ATSDR's use of epidemiological studies, which they contend are inappropriate tools to determine whether a community has experienced environmentally induced disease or other health effects, mainly because the exposed community is usually too small to be accurately assessed through statistical analysis.

As the EHN/NTCP report observes, "connecting toxic pollution with specific outbreaks of illness is scientifically and politically charged." Affected communities "often look to public health experts to vindicate their suspicions of a causal link between illnesses and toxic sites and to provide authoritative recommendations" to prevent further exposure, the report said. While acknowledging "we may never know conclusively in many toxic-saturated neighborhoods whose illnesses were and were not caused by the chemical-laden environment," the report said the absence of epidemiological evidence should not prevent public health agencies from recommending measures to prevent or reduce exposures.

ATSDR Director William Roper, in a written response to the report requested by Senate Majority Leader George Mitchell (D-Maine), said the agency "took strong issue with the premise" that it would conduct health studies that were intended and designed to ignore health risks associated with a hazardous waste site, or that epidemiology "was not useful in the study of hazardous waste sites." Roper said even studies that are designed and implemented perfectly may produce "inconclusive results if the true rates of illness in a population exposed to a hazardous substance are the same as those in a population not exposed."

Roper acknowledged that a potentially affected community may be too small to "satisfy the statistical requirements of a study." For this reason ATSDR is developing multisite studies that pool data from populations with similar exposures to hazardous substances, thereby enhancing the likelihood that studies will produce statistically significant correlations between exposure and illness.

But ATSDR defended the role of epidemiological evidence in making final public health judgments about preventing exposure. The NTCF/EHN report urged ATSDR to shift from relying on epidemiological evidence to other indicators of potential health effects such as laboratory testing as the principal guidance for determining how to prevent or reduce exposure.

In response, ATSDR said it uses environmental data, health information, "including epidemiological as well as other scientific information," and public health concerns and input "to reach scientifically valid and consistent public health decisions." Roper said ATSDR has sought to increase contact with affected communi-

ties, citing specifically the establishment of community assistance panels which are used to help identify community health concerns.

According to Maureen Lichtveld, chief biomedical officer for public health practice at ATSDR, since establishment of community assistance panels, ATSDR has made dramatic changes to protocols for health studies, including the community assistance panel recommended changes in the population targeted for study and in the control group. "Those are very key portions of a protocol of any study," she commented.

ATSDR

Maureen Lichtveld—Community assistance panels have dramatically affected the way ATSDR performs studies.

EHN's Linda King agrees that the agency's responsiveness to community groups has improved. "The [EHN/NTCF] report not only spurred changes within the agency, but educated the public about the changes they could demand. Now people are more educated and willing to be demanding." In addition to the community assistance panels, ATSDR has hired staff to interact with minority communities and formed special committees to deal with federal sites.

Still, King believes that communities are wary of ATSDR and are reluctant to cooperate with the agency. "Would you want the agency to do a health study where they have consistently never found a connection between the chemicals and the symptomatology?"

Linda King—Government assessments of health effects may be suspect.

But Johnson points out that ATSDR receives 90 petitions each year to conduct health assessments, 55% of which are received from citizen groups or individuals. "I don't think ATSDR would be receiving 90 petitions if there was a widespread feeling that we are incompetent or untrustworthy," he said.

Sites Specific

The petition process, which was included in the Superfund reauthorization law, is designed to "provide individual citizens with a way of identifying hazardous waste sites that may have escaped traditional discovery mechanisms," according to Johnson. In fact, ATSDR, in response to petitions for health assessments, has discovered serious health concerns at sites not listed on the NPL. For example, in 1989, the agency issued a public health advisory recommending that residents be relocated from the Forest Glen mobile home park in Niagara Falls, New York, which was built atop an industrial landfill and was contaminated with high levels of polyaromatic hydrocarbons and other pollutants. After the advisory, EPA listed the site on the NPL.

In another suchinstance, in 1990 ATSDR issued a public health advisory for a hazardous waste incinerator in Lenoir, North Carolina, that was licensed as a hazardous waste treatment facility and permitted to burn wastes at twice the amount specified in the incinerator's design rate. Workers and residents complained of health effects from exposure to incinerator emissions. The incinerator was closed by the county health department in 1988.

In January 1993, ATSDR completed a symptom and disease prevalence study of the Lenoir area and concluded that residents of the area had a statistically significant increase in the prevalence of irritant, respiratory, and neurological symptoms versus the comparison population, although the prevalence of self-reported cancers and reproductive outcomes was not higher in the Lenoir area versus the comparison population. ATSDR advised that respiratory and immune function be evaluated with biomarker testing of persons living within 0.9 miles of the incinerator.

The agency's actions in Lenoir, North Carolina, and at the Forest Glen mobile home park win praise from Linda King, but she and the agency disagree about ATSDR's handling of the Bunker Hill Superfund site, a 21-square mile mining and smelting complex in Kellogg, Idaho.

ATSDR's health assessment of Bunker Hill in 1988 is cited in the GAO report issued in 1991. GAO said ATSDR conducted the assessment without visiting the site and was unaware of the access citizens had to the site and therefore understated the risk the site posed to public health.

In 1989, however, ATSDR issued a public health advisory, after EPA had requested that ATSDR examine the health impacts of specific areas of the smelter complex, according to Greg Thomas, ATSDR regional representative. Thomas said ATSDR identified "some pretty significant health problems," most of which stemmed from uncontrolled access to highly contaminated areas of the facility.

Piles of waste containing high concentrations of arsenic were not fenced off or otherwise secured. Similarly, transformers containing PCBs were accessible to children and adults, as were storage tanks containing mercury sludges. After the public health advisory, the site was secured.

ATSDR is convinced that significant exposure to the surrounding community has occurred from the site, Thomas said, noting that in the mid-1970s the plant operated without its air pollution control devices functioning and dumped large quantities of lead into the air. But ATSDR does not have a clear picture of the health outcomes that may have been caused by past exposure, such as elevated cancer rates.

"We've tried to focus our efforts not on whether people had been exposed, but on how to stop exposure from happening and to identify how people had been exposed," Thomas said. ATSDR has focused on breaking exposure pathways by encouraging homeowners to keep their yards covered with vegetation, educating children about soil ingestion, and urging residents to control indoor dust.

Since 1986, children ages 9 months to 9 years have undergone blood lead testing, and children with elevated levels receive follow-up screening. Blood lead levels in recent testing are largely no greater than 25 micrograms per deciliter (μg/dl), and are primarily in the 10–15 μg/dl range, Thomas said, noting that CDC does not recommend consultation with a physician for levels of 10 μg/dl or below. Average background levels of blood lead in children range between 3 and 7 μg/dl.

Thomas said the county health department operates a program to test blood lead levels of pregnant women, though ATSDR does not conduct or fund any adult screening. Adults can be tested by local physicians, and the tests are relatively inexpensive, he said. "The children are the most sensitive [to lead]. If kids' blood leads are under control, we think that it's likely most adult blood leads are also under control."

ATSDR is urging EPA in its EPA's Superfund lawsuit against parties responsible for the site to include a health component in the settlement, though Thomas declined to offer further details because the matter is still under negotiation.

King believes the agency ought to be focusing on the lead body burden of Kellogg children through fluorescent bone testing. She says the agency is overlooking possible impacts on older children who have long been exposed to lead, as well as

pregnant women and women of childbearing age. The community, she said, needs a clinic to exclusively treat lead-related problems such as learning disabilities. Incomes in the area are low, making it difficult for residents to obtain needed health care, according to King.

Thomas said ATSDR is unclear what would be learned from bone testing, noting that no standards exist for bone lead. "We can measure it, but we don't know what [the numbers] mean," he said. "We still feel blood lead is the best way to determine exposure."

Johnson said he is proud of the ATSDR's work at Bunker Hill. "This agency, and before us, CDC, identified the problem of childhood lead exposure in the community," he said. The "progressive decline in blood lead levels didn't occur by accident. It occurred because of concerned intervention by local, state, and federal authorities."

While ATSDR has been criticized for doing too little to protect human health in Kellogg, EPA has been embroiled in a nasty dispute with citizens and officials in Aspen, Colorado, who have accused EPA of overstating the health risks posed by lead contamination from the Smuggler Mountain Superfund site there.

At issue is EPA's proposed remedy for cleaning up contaminated soils from an abandoned mine in an area where a mobile home park and condominium complex are now located. Initially, EPA proposed excavating two to three feet of soil contaminated with lead and other heavy metals, in concentrations ranging from well below 500 parts per million (ppm) to as much as 70,000 ppm, according to Brian Pinkowski, cleanup project manager in EPA's Region VIII.

Pinkowski said EPA realized that its cleanup plan would require temporary relocation of citizens, but the agency was unaware of the level of opposition that existed until it sought access to resident's property to begin the cleanup process.

In developing the cleanup plan, EPA conducted a risk assessment based on the lead levels in the soil, the likely pathways of exposure, and included assumptions about the level of soil ingestion that would be expected by area children. The goal was to clean up the soil so that lead levels would not exceed 1000 ppm, which, based

It's A Dirty Job But Someone Has To Do It

And the goal of the Hazardous Waste Worker Training Program is to make sure its done right. Since its initiation in 1987, the program, administered by NIEHS, has developed a strong network of nonprofit organizations committed to protecting workers and their communities by delivering a high-quality, peer-reviewed safety and health curriculum to the target populations of hazardous waste workers and emergency responders.

Not exactly fun and games. The Oil Chemical and Atomic Workers Union trains members at a mock site in nuclear waste decontamination protocol.

Congress identified these workers in Section 126 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). During the five years the program has operated, it has supported 18 primary grantees, including major universities, labor unions, community colleges, and labor-management training funds. These grantees have trained over 300,000 workers across the country and presented over 7,000 classroom and hands-on training courses, accounting for almost 4 million contact hours of actual training.

Through the encouragement of multistate, university-based consortiums and the development of national nonprofit organizations focusing on specific workforce sectors, the worker training program has established curriculum materials and course presentations that have become national benchmarks for worker safety and health training. The worker training program has been taught to hazardous waste workers and emergency responders in every region of the country. The program's prevention activities also provide a major benefit to communities by delivering technical scientific and basic research information to target populations with high risk of toxic exposures.

NIEHS administers the Hazardous Waste Worker Training Program through an interagency agreement with the EPA. The traditional peer-review process of the National Institutes of Health oversees grant application reviews, grants management, and program administration. Technical experts in toxicology, industrial hygiene, labor, education, and hazardous waste management from both the public and private sectors assure that the supported programs demonstrate technical merit and adhere to stringent standards for quality control through periodic site reviews and ongoing peer review.

With a recent additional appropriation from Congress of $10 million, the program will expand the scope of its national effort to include training opportunities for workers involved in cleaning up radioactive and hazardous waste sites in the Department of Energy's nuclear weapons complex. Seven new awards had been made through the program as of July 1993.

Data on the economic value of future environmental cleanup activities indicate that many more workers will need basic safety and health training. The safety and health problems at toxic waste cleanup sites, which Congress had envisioned would be addressed by SARA, have substantially increased in extent and severity. After initial delays in remediating at waste sites, the EPA Superfund program has been supplemented with even larger environmental restoration programs by the Departments of Energy and Defense.

Acknowledgment by public health experts of the risks posed by lead, asbestos, and mercury is spawning yet another waste cleanup industry, which must be regulated and whose workers must be trained to ensure that proper precautions are taken to protect both the public and potentially exposed workers. Continued support for high-quality worker safety and health training is an essential component of an effective national environmental cleanup program.

Joseph Hughes

on lead ingestion studies, can produce blood lead levels of 10 µg/dl, according to Pinkowski.

EPA found it difficult to convince residents that the remedy was necessary, given that lead levels of 10 µg/dl produces rather questionable symptoms, such as slight intelligence quotient (IQ) deficits and irritability. EPA's position was also undermined by actual blood lead testing of children and adults that had been conducted by the state health department with funding from ATSDR and showed blood lead levels on average of 3 µg/dl. Despite the low blood lead levels, ATSDR concluded that the children were at high risk of lead exposure.

An EPA technical advisory committee was formed to assess health risks posed by the site. It concluded, in a report issued in October 1992, that the soil lead at the mining site does not pose a "realistic health threat" or "an unacceptable risk of disease or impairment" to residents on or near the site.

For the citizens of Aspen, the advisory committee's report was a hard-fought victory, according to Terry Hale, an Aspen dentist who has fought EPA's cleanup plan and testified about the effort before a Senate Environment Subcommittee in May. Hale said the Aspen fiasco reflects EPA's inability to make risk assessments. "The agency failed to distinguish between a medical hazard and a potential hazard." But he acknowledged that EPA is mandated by Congress to protect citizens from "potential harm," calling the statutory language "a glitch in the law."

The Aspen controversy also reflects the difficult public policy questions confronting agencies dealing with hazardous waste sites: how much precaution is necessary to protect public health? How should we measure risk? On these points, there is little agreement among scientists or politicians.

The Guessing Game

The risk assessment process used by EPA, in which exposure levels are extrapolated from models and combined with toxicology data to estimate the incremental risks of cancer associated with the exposure, is assailed by critics who believe the risk assessment process understates or overstates the human risk.

Renate Kimbrough, of the Washington, DC-based Institute for Evaluating Health Risks, said federal agencies wrongly assume that every hazardous waste site presents a human health risk. "We need to determine whether there are pathways of exposure," and whether exposure levels are in excess of background levels, she said. Kimbrough, a toxicologist who formerly assessed hazardous waste sites for CDC, said most sites do not offer "meaningful exposure pathways" and therefore do not present a health risk.

"When you have heavy contamination of fish with persistent chemicals, if there is transmission of [chemicals] through a food chain, or if you have contaminated drinking wells, then you have the potential for exposure. But if those sorts of things don't exist, then you don't have that exposure," she said. "Public officials need to be able to make the decision and say that a particular site doesn't present a problem" and requires no remedial action, Kimbrough continued. "At the moment we don't have that luxury. The universal assumption that all of these sites are health hazards is totally illogical."

Linda Birnbaum, director of the environmental toxicology division of EPA's Health Effects Research Laboratory, agrees that inadequate information about human exposure is a key issue facing regulators and public health officials. But Birnbaum said developments in the use of biologic markers may shed additional light on whether humans have been exposed. If researchers know that certain chemicals produce cellular molecular changes in animals, human exposure can be inferred when such changes are found in potentially exposed humans, she noted. "I think where we're moving is toward biomarkers to assess exposure. It's a new area, and a new push. Some chemicals, such as benzene, are only detectable for a short time after exposure, making biomarkers especially important. When you can't follow the presence of a chemical, you have to follow the change," noted Birnbaum.

Birnbaum also believes a much needed change is occurring in how health sciences assess the risks associated with chemicals. Specifically, she cites a shift toward research on other kinds of health effects, such as immune system or reproductive effects, rather than focusing exclusively on carcinogenicity. This shift, coupled with an improved understanding of exposure, will help public health officials target their responses to chemicals that are active, producing multiple health effects and are pervasive in the environment, while drawing attention from chemicals that are less pervasive, lack exposure pathways, or produce a specific kind of cancer in a particular species, but do not seem to affect a wide range of species or produce a variety of cancers or other toxic effects.

In addition, Birnbaum said governmental efforts to characterize risk of hazardous wastes will increasingly draw on a broad base of data: biological markers, epidemiological studies, clinical studies, and animal studies. "It's a more holistic approach," said Birnbaum, than risk analyses based on single studies linking chemicals to one kind of cancer in a specific species. Birnbaum hopes that incorporating all types of data about a chemical's toxicity will also better focus attention on those chemicals that are "bad actors," producing multiple effects in a variety of species.

A similar approach is recommended in a recent report by the National Research Council's Environmental Epidemiology Committee, which was formed at the request of ATSDR to review current knowledge of the health effects caused by exposure to hazardous waste. Devra Davis, scholar in residence at the National Academy of Sciences and project director of the environmental epidemiology report, said the committee urged public health officials to rely on several kinds of information for inferring a causal relationship between exposure and human health, including knowledge about potential exposures; animal studies demonstrating toxicity or carcinogenicity from such exposures; knowledge about health risks from similar exposures in other circumstances, including the workplace, and studies that reveal symptomatology or disease in those exposed to hazardous waste sites, which may demonstrate an association between the exposure and the health effects.

Although the committee concluded that too little information was available to adequately assess the impact of hazardous waste on public health, Davis said she and the committee were concerned that uncertainty about health effects might prompt regulators to require human data before taking action to prevent exposure. "Some people think we should have a dead body approach to regulation," she said, in which agencies would not regulate or cleanup hazardous wastes until epidemiology studies had showed a statistically significant increase in disease in humans exposed to a hazardous substance.

Davis noted that, where health effects are thought to stem from substances generated by significant economic activities, researchers must provide overwhelming evidence to demonstrate the hazards of the substance to convince public policy makers to act. Davis cited the evolution of public policy toward cigarettes in the United States. As early as the late 19th century, pathologists were warning that cigarettes caused lung cancer, but the strength and importance of the tobacco industry prevented public health officials from addressing the lung cancer issue earlier.

Today, the general population suffers from largely unexplained increases in breast, prostate, and testicular cancers, as well as sharply reduced sperm counts and a baffling increase in asthma, said Davis. The

rate of change in the prevalence of the diseases "suggest something is going on in the environment," because no big changes have occurred genetically, nor have American diets changed greatly, she said. Public health officials need to identify the risks of substances before the risks manifest in increased disease.

William Suk, director of NIEHS's Extramural Superfund Basic Research Program, noted that there are a large number of substances and mixtures that have been identified in uncontrolled hazardous waste sites or have been inadvertently released; however, data on how these substances are changed as they migrate through soil, air, and water are limited. Says Suk, "There are limits on our understanding of how these substances enter the food chain and how they may otherwise be ingested, inhaled, or absorbed by people. Furthermore, techniques to measure the extent of exposure in people and to detect subtle or serious health effects that are clearly related to such exposures are not widely available." He did note, however, that there have been successes in targeted research areas such as those that develop methods and technologies to reduce the amount and toxicity of hazardous substances. Suk attributes their success to the close linkage of biological and toxicological expertise with skills in such fields as chemical engineering, microbiology, ecology, hydrogeology, and related fields.

Grants made under the NIEHS Superfund Program are for multicomponent, multidisciplinary programs. Such a program is unique, maintains Suk, because it succeeds in bringing together the biomedical sciences with engineering, ecology, and the geosciences to explore hazardous waste problems.

Suk maintains that the advent of sophisticated tools, techniques, and advances in biomedical research will allow for a more detailed understanding of the molecular basis of biological function, thereby allowing greater control. Likewise, with the development of innovative environmental technologies, sites will be more effectively remediated.

According to Suk, "Cleanup of contaminated soils, sediments, and groundwaters is not only for improvement of the environment, but is also a means by which human exposure and health risks can be reduced, or indeed prevented, specifically by reducing the amount and toxicity of hazardous substances."

ATSDR's Johnson believes that public health agencies, when faced with uncertainties about the human health effects of hazardous waste and the ethical imperative (and congressional mandates) requiring agencies to act in spite of such uncertainties must anchor their activities to widely accepted scientific principles.

Independent peer review by experts representing diverse perspectives will help agencies sort through areas of controversy and achieve results close to the scientific consensus. Government agencies "have to act on the basis of what good science says to us, and what acceptable public health practice is. We can't undertake a major intervention in the absence of supportive science, but we can't delay what we think are necessary actions because all the science isn't in," Johnson noted. "It's a balancing act that we in public health, especially environmental health, have to perform."

Karen Breslin

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